Chapter 5
Waterproofing

Section 500.0 Scope

Sec. 500.1 Purpose: This chapter shall govern the design, use, and methods of construction and materials with respect to obtaining, for a given space, the degree of protection against water, water vapor, and waterborne contamination determined by the vulnerability or hazard potential of the contents and interior finish materials to meet its flood proofing classification.

Sec. 500.2 Performance Standards: Three types of waterproofing are defined herein as to the degree to which they satisfy a standard of dryness. If any material or methods of construction meets the functional performance standard defining a type of waterproofing construction it shall be considered as satisfying the requirements of this chapter. For the purpose of these Regulations, the detailed specification of Type A waterproofing construction, as contained in this chapter, shall be interpreted as a guide to measures which are reasonable prerequisites for attaining this standard of dryness.

Section 501.0 Type A Constructions

Sec. 501.1 Permeability: Type A waterproofing constructions are completely impermeable to the passage of external water and water vapor under hydrostatic pressure of flooding to the RFD. Type A waterproofing construction shall consist of either a continuous membrane satisfying 501.2, integrally waterproofed concrete satisfying 501.3, or a continuous interior lining satisfying 501.4.

Sec. 501.2 Type A Membrane Construction: Type A membrane waterproofing forms a continuous external impervious lining to protect a structure with a concrete floor slab and concrete or reinforced concrete masonry unit walls. It shall comply with the following requirements for structural prerequisites, materials, and installation.

Sec. 501.2.1 Structural Prerequisites:

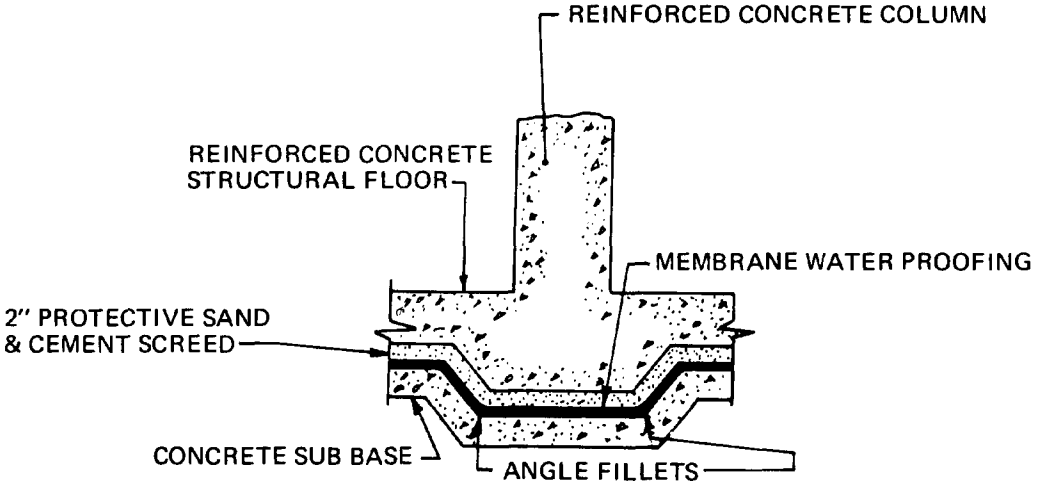
Sec. 501.2.1.1 Continuity of Structure: Structural slabs below grade shall be continuous under perimeter walls to prevent differential settlement and shall be designed to act monolithically with the walls; reinforced concrete masonry unit walls shall be connected rigidly to slabs with reinforcing steel. Where conventional footings are necessary to achieve bearing below the frost line, the structural slab shall be formed monolithically with the walls or anchored into the walls by means of a keyway and reinforcing steel so as to act monolithically with the wall.

Sec. 501.2.1.2 Projection of Slab: Where a slab is continuous under perimeter walls, it shall project not less than six inches beyond the outside of the wall in order to provide space for joining horizontal and vertical membranes.

Sec. 501.2.1.3 Columns: Where columns occur, there shall be no vertical discontinuity or abrupt change in slab cross sections. Where slab thicknesses change, they shall do so gradually, and the effects of pressure distribution on the thinner portions of the slab cross section shall be considered.

Sec. 501.2.1.4 Protection: All membranes shall be installed on exterior surfaces of perimeter walls. For floor slabs, the membrane shall be installed between the structural slab and wearing surface or otherwise placed on a non-structural concrete subbase at least two inches in thickness to protect the membrane and ensure its flatness; in the latter case (Figure 4), a two-inch thick sand-cement screed shall be placed over the membrane before laying reinforcing steel for the structural slab. If a floor membrane is sandwiched between two structural slabs, the membrane shall be positioned at a location that will not subject it to excessive overstress conditions.

Sec. 501.2.1.5 Pile Foundations: When spaces are supported on pile foundations, there shall be complete separation between pile caps and floor slab; the membrane shall be continuous and loads shall be transferred to the piles through basement walls acting as deep beams or through isolated foundations. The pile caps shall be interconnected with stabilizing beams and a reinforced concrete slab not less than four-inches thick shall be provided over the entire area between the beams (and monolithic with them) in order to receive membrane.



TYPE "A" MEMBRANE WATER PROOFING IN FLOOR SLABS

Figure 4

Sec. 501.2.2 Materials: For the purpose of these Regulations, a membrane shall be any layered sheet construction of tar/asphalt bitumen and felts, at least 3-ply in thickness neoprene coated nylon fabric; other approved sheet material; or multiple applied hydrolithic coatings of asphaltic bitumens. All applicable ASTM standards shall apply to Type A membranes and their component parts. Relevant ASTM standards include the following standard numbers: D4637, D3083, C836, D2626, D3393, E96 and C898.

Sec. 501.2.2.1 Plastic Waterproofing Materials: Various plastic materials, including among others, polyethylene, PVC, polyurethane, and polyisobutylene, shall be permitted in sufficient thicknesses in sheets or coatings. In certain cases, the Building Official may require less protection beneath the plastic than the concrete subbase required in 501.2.1.4.

Sec. 501.2.3 Installation:

Sec. 501.2.3.1 Application: All Type A membrane waterproofing shall be applied by a certified roofing or waterproofing contractor.

Sec. 501.2.3.2 Turns: Turns at corners, both vertical and horizontal, shall be made with chamfers or fillets of not less than two inches dimension on any side.

Sec. 501.2.3.3 Seams: Membrane seams or overlaps, if any, shall be thoroughly interleaved and protected in accordance with accepted practice, but in no case shall seams or overlaps be less than two inches in any direction.

Sec. 501.2.3.4 Pipes: Points where pipes or ducts penetrate waterproofed construction shall be designed to be watertight in accordance with accepted engineering practice.

Sec. 501.2.3.5 Joints: Membranes shall be continuous across expansion, control, and construction joints, which shall have waterstops of rubber, copper, plastic, or other suitable materials.

Sec. 501.2.3.6 Protection: Membranes on walls shall extend at least three inches above the RFD of the protected space and shall be attached with a reglet or covered with protective masonry at its upper termination. To protect all wall membranes during backfill operations, protection of not less than ½-inch thickness of cement parging, plastic sheets, or other rigid non-cellulose material, installed in a workmanlike manner, shall be provided; however, in large projects or where the aforementioned protection may not be adequate, the Building Official may require protection by some other means.

Sec. 501.2.3.7 Excavation: Excavation preceding construction shall extend a minimum distance of 24 inches beyond the exterior wall lines to facilitate construction operations. In built-up areas where this requirement cannot be met, excavation limits will be as designated by the Building Official.

Sec. 501.3 Type A Integrally Waterproofed Concrete Construction: Type A integrally waterproofed concrete construction shall comply with the following requirements for structural prerequisites, materials, and installation.

Sec. 501.3.1 Structural Prerequisites:

Sec. 501.3.1.1 Continuity of Structure: Structural slabs shall be continuous under perimeter walls. Slabs shall be designed to act monolithically with perimeter walls, or otherwise shall carry them nonrigidly in a recess with mastic V fillings and waterstops. (Figure 5) Where conventional footings are necessary to achieve bearing below the frost line, the structural slab shall be formed monolithically with the walls or anchored into the walls by means of a keyway and reinforcing steel.

Sec. 501.3.1.2 Deflections: To prevent increases of permeability in tension zones, the maximum deflection of any structural slab or perimeter wall shall not exceed 1/500 of its shorter span.

Sec. 501.3.1.3 Columns: Where columns occur there shall be not vertical discontinuity or abrupt change in slab cross section. Where slab cross sections change, they shall do so gradually, and the effects of pressure distribution on the thinner portions of the slab cross section shall be considered.

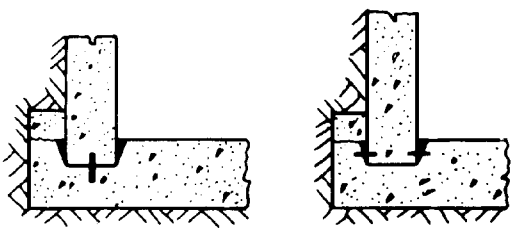
Sec. 501.3.2 Materials:

Sec. 501.3.2.1 Strength: All Type A integrally waterproofed concrete shall have a seven-day compressive strength of at least 3,000 psi and a 28-day compressive strength of 4000 psi.

Sec. 501.3.2.2 Waterproofing Admixtures: If an approved waterproofing admixture is used, the cement content required to achieve the strength specifications may not be reduced by more than 10 percent. Approved admixtures shall not reduce the compressive strength of the concrete and shall act as a densifier and to increase workability.

Sec. 501.3.2.3 Joints: Expansion joints shall be keyed and provided with waterstops. Construction joints shall be provided with waterstops and shall be thoroughly roughened and cleaned before continuation of concrete placement.

Sec. 501.3.2.4 Protection of Fresh Concrete: When potentially aggressive groundwater conditions exist, the Building Official may require the protection of fresh concrete from contact with groundwater for a minimum of 14 calendar days. Protection shall be accomplished either by the removal of groundwater or by the application of a temporary membrane or surface coating (e.g. bitumen or tar emulsion) which, however, need not meet standards for permanent protection.



NON-RIGID PERIMETER WALL AND FLOOR SLAB CONNECTIONS

Figure 5

Sec. 501.4 Type A Interior Linings: A Type A interior lining forms a continuous internal impervious barrier to protect a structure with a concrete floor slab and concrete or reinforced concrete masonry unit walls. All Type A interior linings shall conform to the following requirements for structural prerequisites, materials, and installation

Sec. 501.4.1 Structural Prerequisites

Sec. 501.4.1.1 Continuity of Structure: Structural slabs below grade shall be continuous under perimeter walls to prevent differential settlement and shall be designed to act monolithically with the walls; reinforced concrete masonry unit walls shall be connected rigidly to slabs with reinforcing steel. Where conventional footings are necessary to achieve bearing below the frost line, the structural slab shall be formed monolithically with the walls or anchored into the walls by means of a keyway and reinforcing steel so as to act monolithically with the wall.

Sec. 501.4.1.2 Columns: Where columns occur, there shall be no vertical discontinuity or abrupt change in slab cross sections. Where slab thicknesses change, they shall do so gradually, and the effects of pressure distribution on the thinner portions of the slab cross section shall be considered.

Sec. 501.4.1.3 Deflections: To prevent cracking of the interior lining, the maximum deflection of any structural slab or perimeter wall to which the lining is applied shall not exceed 1/500 of its shorter span.

Sec. 501.4.2 Materials: For the purpose of these Regulations, an interior lining shall be any continuous coating, parging, or rendering of a cementitious, or other approved waterproofing material or compound with adequate structural strength and impermeability to serve its intended purpose. All relevant ASTM standards shall apply to Type A interior lining materials. Relevant ASTM standards include the following standard numbers: D4637, D3083, C836, D2626, D3393, E96 and C898.

Sec. 501.4.3 Installation:

Sec. 501.4.3.1 Application: All Type A interior lining waterproofing shall be applied by a certified roofing or waterproofing contractor.

Sec. 501.4.3.2 Turns: Turns at corners, both vertical and horizontal, shall be made with fillets of not less than two inches dimension on any side.

Sec. 501.4.3.3 Pipes: Points where pipes or ducts penetrate waterproofed construction shall be designed to be watertight in accordance with accepted engineering practice.

Sec. 501.4.3.4 Joints: Interior linings shall be continuous across expansion, control, and construction joints which shall have waterstops of rubber, copper, plastic, or other suitable material.

Sec. 501.4.3.5 Vertical Extent: Interior linings on walls shall extend at least three inches above the RFD of the protected space.

Sec. 501.5 Existing Spaces: Spaces in existing buildings or structures which become subject to these Regulations may be approved as having Type A waterproofing upon submission by the Owner of plans and specifications for these spaces prepared by a licensed architect or engineer; however, the Building Official shall make a thorough inspection of actual site conditions and may require that tests be made to demonstrate the adequacy of the work before granting this approval.

Section 502.0 Type B Constructions

Sec. 502.1 Permeability: Type B waterproofing construction shall be substantially impermeable but may pass water vapor and seep slightly during flooding to the RFD. Large cracks, openings, or other channels that could permit unobstructed passage of water shall not be permitted. In no case shall there be permitted the accumulation of more than four inches of water depth in such a space during a 24-hour period if there are no devices provided for its removal. However, sump pumps shall be required to control this seepage.

Sec. 502.2 Upgrading Existing Spaces: Spaces with Type B waterproofing construction may be upgraded to Type A through the installation of a continuous exterior or interior lining or a combination of both which the Building Official may approve as meeting the requirements for permeability of Type A waterproofing.

Sec. 502.2.1 Inspections: The Building Official shall make inspections prior to and upon completion of this work before approving the completed work as meeting Type A waterproofing requirements. The Building Official may require that tests be made to demonstrate the adequacy of the work before granting this approval.

Section 503.0 Type C Constructions

Sec. 503.1 Non-Waterproofed: Type C waterproofing constructions are any which do not satisfy the requirements for Type A or B in 501.0 and 502.0, respectively.

Sec. 503.2 Upgrading of Spaces: Non-waterproofed spaces may be upgraded to Type A or B waterproofing when the Building Official shall approve such work as meeting the standards for Type A or B in 501.0 and 502.0, respectively.

> **Sec. 503.2.1 Inspections:** The Building Official shall make inspections prior to, during, and upon completion of this work before approving the improvements as Type A or B waterproofing, and may require testing be made to demonstrate the adequacy of the work before granting this approval.